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ESTIMATED COST  
FOR PRODUCING DRIED HONEY  
COMMERCIALLY

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## ABSTRACT

This paper gives the estimated equipment, capital and operating cost for drying honey. Assuming certain facilities are available, such as buildings, boilers, etc., the fixed capital required would be \$102,000 and the working capital \$69,000 for a plant to produce approximately 4700 pounds of dried honey in an 8 hour day. If the plant operates 260 days per year, the production would be 1-1/4 million pounds. With bakers' grade honey available at 13 cents per pound (16 cents per pound of solids in the honey), the cost to make is estimated to be 24 cents per pound of dried honey when packaged in cans containing 55 pounds. After deducting depreciation, corporate income tax and sales cost, the processor would receive 12% yearly return on his fixed capital if the selling price were 29 cents per pound of dried honey.

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ESTIMATED COST  
FOR PRODUCING DRIED HONEY COMMERCIALY

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INTRODUCTION

Following the Department press release of October 28, 1960 on dried honey, a great deal of interest was shown by industry in this new product. This publication is issued in response to inquiries on the estimated cost of producing dried honey commercially, using the process developed in this Laboratory<sup>2</sup>. Potential outlets for dried honey would include the baking industry, candy making, and pre-packaged dry baking mixes for household use. A commercial plant designed to produce dried honey could also, with slight modifications, produce a wide variety of dried fruit juices by a similar process<sup>3</sup>. An additional step of incorporating essence into the product is necessary for dried fruit juices.

DESCRIPTION OF PROCESS

The process is shown diagrammatically in Figure 1. A description of each piece of equipment is given in the section headed "Equipment Summary." Honey from feed tank (1) is pumped through heater (3) where it is heated to about 120° F. It then enters evaporator (6) where it is concentrated to 99% solids in one pass at a pressure of 2 inches of mercury absolute. The vacuum in the evaporator is maintained by items (7), (8) and (9). The molten, dried honey containing

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<sup>2</sup> Turkot, V. A., Eskew, R. K., and Claffey, J. B. A Continuous Process for Dehydrating Honey. Food Technology 14: 387-390. 1960.

<sup>3</sup> Turkot, V. A., Eskew, R. K., and Aceto, N. C. A Continuous Process for Dehydrating Fruit Juices. Food Technology 10: 604-606. 1956.

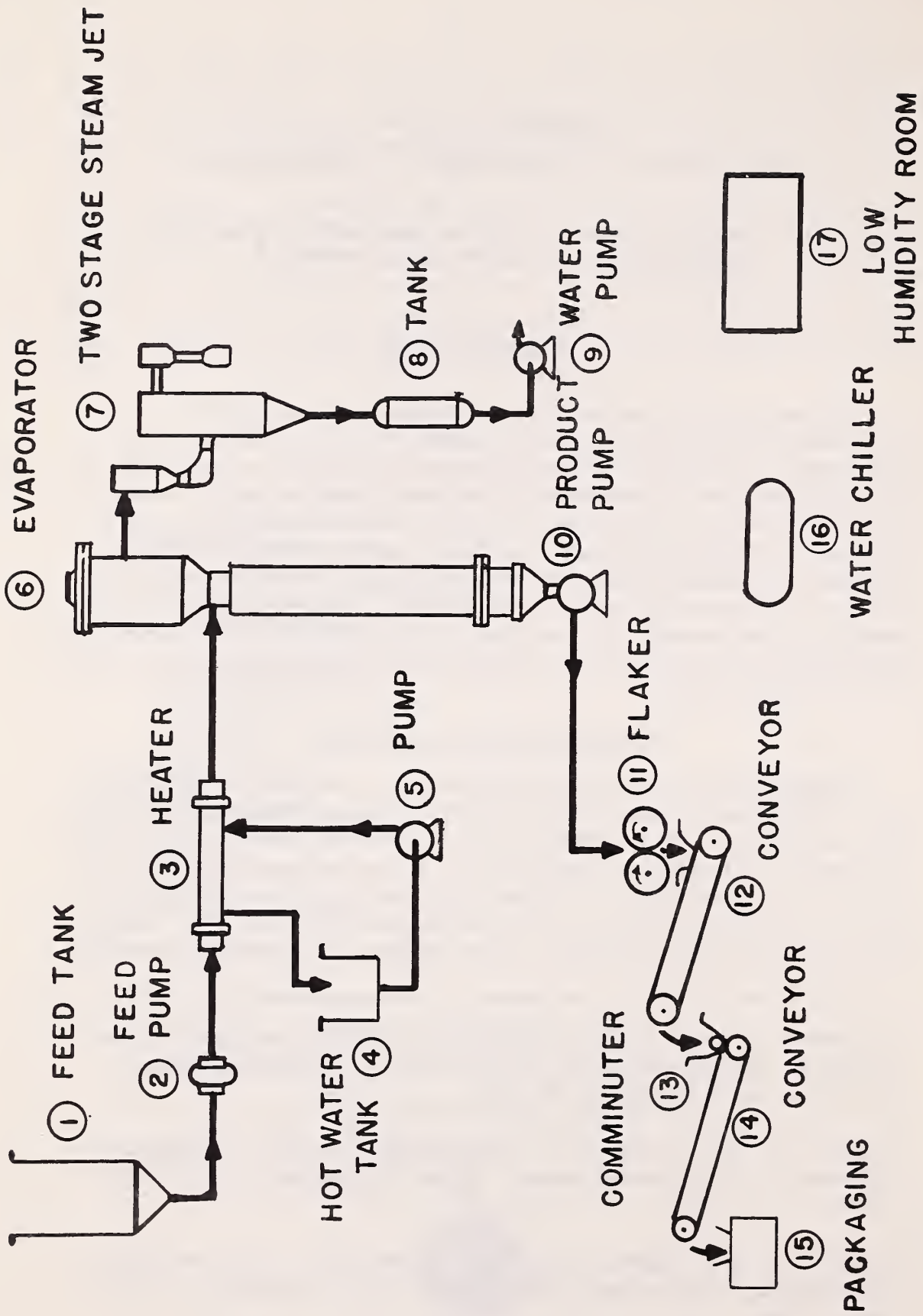


Figure 1. Equipment for processing dried honey

99% solids is pumped by (10) to a flaker (11) which is cooled by 40° F. water from the water chiller (16). The flakes of dried honey are forced through a 6-mesh screen in the comminuter (13) and the product is packaged at (15). Because dried honey is hygroscopic, items (10) to (15) are enclosed in a low humidity room (17). An approved food grade of anti-foam material is added to the extent of 30 parts per million (p.p.m.) of solids in the liquid honey in order to prevent foaming in the evaporator. This may be Dow Corning Company Anti-Foam C.<sup>4</sup> Honey has been dried both with and without the addition of sucrose (ordinary table sugar). When drying with added sugar, the process would be the same as shown in Figure 1 except sugar would be dissolved in water in an auxiliary tank to produce a sirup containing 70% solids. The sirup would be transferred to the feed tank (1) and mixed with honey. The remainder of the operation would be the same for honey with or without added sugar. Sugar will give a more brittle product possessing greater resistance to caking and will permit storage at up to about 85° F. without the product losing its free flowing characteristics. Pure dried honey should be stored below 75° F. to maintain a free flowing product. Resistance to caking at higher temperatures can be obtained by the use of an in-package desiccant. The cost to make dried honey with sugar added equal to 1/3 of the total solids would be approximately 2 cents per pound less than that for pure dried honey. This assumes sugar at 9-1/2 cents per pound and honey at 13 cents per pound. The estimate given in this publication is for pure dried honey.

The water removed from the honey in evaporator (6) has a strong honey odor. In the experimental work, this material was collected separately by installing a surface type of condenser ahead of the steam jets (7) and the condensate obtained was concentrated to produce a honey "essence." Since dried honey possesses adequate flavor without restoring essence, the essence can constitute an important byproduct.

#### BASIC ASSUMPTIONS

Operating Time: The plant would operate 7-1/2 hours per day (allowing 1/2 hour for starting and cleaning), 5 days per week, 260 days per year.

Purchase of  
Honey: Bakers' grade amber honey was available in 1960 at 12 cents per pound delivered in 60 pound cans<sup>5</sup> A

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<sup>4</sup> Reference to certain products or companies does not imply indorsement by the U. S. Department of Agriculture over others not mentioned.

<sup>5</sup> U. S. Agricultural Marketing Service. "Honey Market News" November 17, 1960.

premium of an additional one cent a pound was assumed for honey heat treated to prevent "graining." The honey was assumed to have 82% solids:

Packaging: The dried honey would be packaged in the conventional "50 pound" lard cans which will hold 55 pounds of dried honey. To prevent absorption of moisture, the can and its lid can be sealed with a pressure sensitive tape.

Losses: An overall loss of 2% of the initial honey is assumed; largely occurring during cleaning.

Product: The plant would produce the following quantity of dried honey:

630 pounds per hour  
4,725 pounds per day  
1,228,000 pounds per year

Selling Price: Assuming a 12% yearly return on fixed capital (after depreciation and taxes) the processor would have to sell the dried honey for 29.2 cents per pound.

#### Facilities

Available: The dried honey plant is assumed to be an adjunct to an existing honey plant where other operations are carried on, such as selling honey wholesale, and packaging in cans, or jars. Hence certain items will be in existence. These are charged into the dried honey process as rent rather than as fixed capital. Rent has been charged for the following items: Land and site preparation, roads and parking area, buildings, steam boiler, light delivery truck, office equipment, and fire protection equipment. (Note: The cost of the low humidity room is charged to fixed capital because the possibility of a suitable room being in existence is remote.) In addition, 1/3 of the following charges has been made to dried honey on the basis that the remaining 2/3 would be allocated to existing operations at the plant: General manager at \$10,000 per year, mechanic at \$2.50 per hour, and 3 office employees at a total of \$210 per week.

Tax Rate: The U. S. Corporate Income Tax to be paid on the dried honey operation will depend upon the fiscal policy of the processor. This tax is 30% on the first \$25,000 of profit and 52% on all profit over \$25,000 per year. In this publication, it is assumed that the profit on the other two operations at the honey plant is in excess of



\$25,000 per year and since the dried honey is over and above the processor's normal operations, the tax applicable to dried honey is calculated conservatively, that is, at the maximum rate of 52%. In any actual installation, the profit on existing operations will be known and the tax rate applicable to dried honey can be adjusted accordingly.

## EQUIPMENT SUMMARY

### 1. Feed Tank

Honey in 60 pound cans would be emptied into a 200 gallon stainless steel tank, equipped with agitator and 1/2 horsepower (hp.) motor. \$590

### 2. Feed Pump

This controls the processing rate for the entire operation. It should be a metering type, stainless steel, rated for a minimum of 776 pounds per hour of honey against a 40-foot head. The price includes a 1/3 hp. motor and variable speed drive. \$590

### 3. Heater

To preheat honey and thus reduce the evaporative load of Item 6. It should be stainless steel where in contact with product and should be capable of heating at least 776 pounds per hour of honey from 80° to 120° F. with water at 150° F. in the shell side. \$700

### 4. Hot Water Tank

Wood, capacity about 200 Gallons. \$175

### 5. Pump

Centrifugal, iron construction rated for a minimum of 10 gallon per minute (g.p.m.) against a 30-foot head, including 1/2 hp. motor. \$320

### 6. Evaporator

To concentrate honey to 99% solids. It should be an agitated falling film type, 304 stainless steel, and have sufficient heat transfer surface to evaporate a minimum of 145 pounds per hour of water from the honey at a vacuum of 2 inches of mercury absolute. The price includes a 5 hp. motor. \$13,600

7. Two Stage Steam Jet  
 To maintain the evaporator at 2 inches of mercury absolute; for example, a two stage steam jet with a direct contact condenser between the jets. \$1,160  
 NOTE: If the processor wishes to collect the aroma that is evolved during honey concentration, a stainless steel surface condenser must be installed ahead of the first jet. This would entail an additional cost of about \$1,500.
  
8. Tank  
 Steel, approximately 125 gallons capacity and rated for full vacuum service. \$410
  
9. Water Pump  
 Centrifugal, iron construction, rated for a minimum of 25 g.p.m. against a 50-foot head, including a 1 hp. motor. \$410
  
10. Product Pump  
 This is the most critical piece in the process; if air leaks through the shaft seal of the pump, the product foams and cannot flow to the pump. It should be a metering type, stainless steel, with rotary seal, and rated for a minimum of 630 pounds per hour of molten honey at 250° F. against a 50-foot head. The price includes a 1/2 hp. motor with variable speed drive. \$590
  
11. Flaker  
 Chrome plated or stainless steel double drum with sufficient capacity to chill 630 pounds per hour of molten honey from 250° to 70° F. The price includes a 3 hp. motor with variable speed drive, feed mechanism, and discharge chute. \$14,100
  
12. Conveyor  
 Sanitary type, rubber belt conveyor with cleats, 6 inches wide by 10 feet long, including a 1/2 hp. motor. \$750
  
13. Comminuter  
 Stainless steel, low speed, water cooled so that the product is not heated above 75° F. The price includes a 1 hp. motor. \$1,500

14.	<u>Conveyor</u> Duplicate of Item 12.	\$750
15.	<u>Packaging</u> The scale of operation is too small to warrant automatic packaging equipment. The price includes a small wooden hopper and a scale to weigh 55 pounds of product into a "50 pound" lard can.	\$375
16.	<u>Water Chiller</u> To supply 40° F. water to flaker: Water at 45° to 50° F. would be satisfactory but with higher water temperature, the flakes are not brittle. The chiller should have sufficient capacity to remove the heat from 630 pounds per hour of molten honey at 250° F. and cool the flakes to 70° F. The price includes a 5 hp. motor for the refrigerator and a 1/3 hp. motor for the water circulating pump.	\$1,200
17.	<u>Low Humidity Room</u> Since the dried honey is hygroscopic, items (6) and (10) to (15), inclusive, should be enclosed in a low humidity room. It can be approximately 15 ft. wide, 30 ft. long, 9 ft. high and can be made of plywood with a suitable moisture barrier.  Equipment for supplying dry air should maintain the air in the room at 13 grains of moisture per pound of dry air (approximately 10% relative humidity at 70° F.). The temperature of the air to the room should be lower than 75° F. The price includes a 5 hp. motor.	\$2,280          \$9,350
	<b>TOTAL EQUIPMENT</b>	\$48,850

## CAPITAL COSTS

1.	Equipment (See Equipment Summary)	\$ 48,850
2.	Erection of Equipment (30% of (Line 1 minus Item 17))	11,200
3.	Instrumentation (Necessary instruments)	930
4.	Piping and Ductwork (12% of (Line 1 minus Item 17))	4,500
5.	Erection of Piping and Ductwork (70% of Line 4)	3,100
6.	Power - Installed - (Total of 23-1/2 Kilowatts)	2,530
7.	Insulation (Necessary Steam Lines)	660
8.	Freight on Equipment (2% of Line 1)	930
9.	Contingencies (10% of Line 12)	10,200
10.	Engineering Fees (15% of Line 12)	15,400
11.	Contractor Fees (4% of Line 12)	4,100
12.	Total Fixed Capital	\$102,400
13.	Working Capital <sup>6</sup>	68,800
14.	Total Capital	\$171,200

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<sup>6</sup> Sum of (a) 1 month's supply of raw material, (b) 1 day's supply of semifinished material, (c) 1 week's supply of finished material, (d) accounts receivable equal to 1 month's sales, and (e) operating cash equal to 1 month's cost to make.

OPERATING COST

	COST PER DAY	COST PER POUND OF PRODUCT
	DOLLARS	CENTS
<b>I. <u>FACTORY MANUFACTURING COSTS</u></b>		
<b>A. <u>Direct Production Costs</u></b>		
<b>1. <u>Raw Materials</u></b>		
5821 pounds of honey at 13 cents/pound.....	756.73	16.02
0.17 pounds anti-foam at \$2.48/pound.....	0.42	0.01
TOTAL RAW MATERIALS.....	757.15	16.03
<b>2. <u>Packaging Materials</u></b>		
86 cans at 64.3 cents each.....	55.30	
93 yards of tape at 75 cents/yard.....	1.16	1.19
TOTAL PACKAGING MATERIALS.....	56.46	1.19
<b>3. <u>Labor</u></b>		
( 1 at \$2.50/hour - 1 at \$2.10/hour 1 at \$2.00/hour).....	52.80	1.12
<b>4. <u>Indirect Labor</u></b>		
Supervision (1/3 time at \$10,000/year).....	12.82	
Mechanic (1/3 time at \$2.50/hour).....	6.66	
Office Help (1/3 time at \$210/week).....	14.00	
TOTAL INDIRECT LABOR.....	33.48	0.71
<b>5. <u>Maintenance and Repairs</u> (6% Fixed Capital).....</b>		
	23.63	0.50
<b>6. <u>Operating Supplies</u> (15% of Maintenance).....</b>		
	3.54	0.07
<b>7 <u>Utilities</u></b>		
Steam (6400 pounds at 80 cents/1,000 pounds)....	5.12	
Electricity (205 kw.-hr. at 3.33 cents per kw.-hr.).....	6.83	
Water (20,000 gal. at 5 cents/1,000 gal.).....	1.00	
TOTAL UTILITIES.....	12.95	0.27
<b>DIRECT PRODUCTION COST (Sum of 1 to 7)</b>	<b>940.01</b>	<b>19.89</b>

- continued -

	<u>COST PER DAY</u>	<u>COST PER POUND OF PRODUCT</u>
	<u>DOLLARS</u>	<u>CENTS</u>
<b>B. <u>Fixed Charges</u></b>		
8. <u>Insurance</u> (1% Fixed Capital).....	3.94	0.08
9. <u>Taxes</u> - Real Estate (2% Fixed Capital).....	7.88	0.17
10. <u>Depreciation</u> (10% Fixed Capital).....	39.38	0.84
<b>11. <u>Rent</u></b>		
Processing Building (see Table Below).....	40.92	0.87
Steam Boiler (see Table Below).....	3.92	0.08
For Miscellaneous Services (see Table Below).....	4.47	0.09
TOTAL FIXED CHARGES (Sum of 8 to 11).....	<u>100.51</u>	<u>2.13</u>
<b>C. <u>Plant Overhead Costs</u></b>		
<b>12. <u>Non-Wage Payments</u></b>		
Social Security (2-1/2% on first \$4,800 per year)	2.91	
Workmens Compensation (1-1/4% Labor - 1/2% Office)	0.83	
Unemployment Insurance (5.7% Total Payroll).....	<u>4.92</u>	
TOTAL NON-WAGE PAYMENTS.....	8.66	0.18
<b>13. <u>Laboratories</u></b>		
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<b>14. <u>Miscellaneous Factory Expenses</u>.....</b>		
	<u>10.00</u>	<u>0.21</u>
TOTAL PLANT OVERHEAD (Sum of 12 to 14).....	18.66	0.39
TOTAL MANUFACTURING COST (Sum of A, B and C)...	1,059.18	22.41
<b>II. <u>GENERAL EXPENSE</u></b>		
D. Interest on Working Capital (5%).....	13.23	0.28
E. Research and Development (2% Sales).....	27.55	0.58
F. Administration and General (15% of sum of Labor Supervision, Maintenance and Supplies) .....	<u>13.92</u>	<u>0.30</u>
TOTAL GENERAL EXPENSES (Sum of D to F).....	54.70	1.16
III. <u>COST TO MAKE</u> (Sum of I and II) .....	1,113.88	23.57
IV. <u>SELLING COST</u> (10% Selling Price).....	137.77	2.92
V. <u>PROFITS AND DISCOUNTS</u> (See Financial Analysis).....	<u>126.02</u>	<u>2.67</u>
VI. <u>SELLING PRICE</u> (Sum of III, IV and V).....	1,377.67	29.16

RENT CHARGED FOR FACILITIES AVAILABLE

	BUILD- ING	STEAM BOILERS	LAND	SITE PREPA- TION	ROADS AND PARKING AREA	TRUCK	OFFICE EQUIP.	FIRE PROTEC- TION EQUIP.
Size	40 ft. wide 75 ft. long 15 ft. high	906 lb. per hr. 100 lb. per sq. inch	1 acre		8000 sq. ft.	1 ton		
Unit Price..Dollar	25.47 per sq. ft.	6.37 per lb. per hr.			3.75 per sq. yd.			
Cost.....Dollar	76,400	5,770	300	600	3,110	3,500	3,500	1,500
<u>Charges</u>								
Interest %	5	5	5	5	5	5	5	5
Taxes %	2	2	2	2	2	4	2	2
Insurance %	1	1	0	0	0	5	1	1
Depreciation %	3	4	0	0	10	20	10	10
Maintenance %	<u>3</u>	<u>8</u>	<u>5</u>	<u>5</u>	<u>5</u>	<u>10</u>	<u>5</u>	<u>5</u>
TOTAL %	14	20	12	12	22	44	23	23
Rent per year...Dollar	10,640	1,154	36	72	684	1,540	805	345
Rent per operating day (260 days per year)....Dollar	40.92	4.44	1/3 charged to Dried Honey Total of \$4.46 per Operating Day					

## FINANCIAL ANALYSIS

1.	Gross Annual Sales (1, 228,000 lbs. at 29.16 per lb.)	\$358, 193
2.	Returns, Allowances, Discounts (2% of Line 1)	<u>7, 164</u>
3.	Net Annual Sales (Line 1 minus Line 2)	\$351, 029
4.	Annual Factory Cost (\$1,059.18 per day x 260 days per year)	<u>275, 387</u>
5.	Gross Annual Profit (Line 3 minus Line 4)	\$ 75, 642
6.	Administration, Research, Selling and Interest on Working Capital (Sum of daily cost x 260 days per year)	<u>50, 042</u>
7.	Annual Profit before Taxes (line 5 minus Line 6)	\$ 25, 600
8.	Corporate Income Tax (52% of Line 7)	<u>13, 312</u>
9.	Net Annual Earnings (Line 7 minus Line 8)	\$ 12, 288
10.	Earned on Fixed Capital (Line 9 divided by \$102,400 x 100)	12%

## PARTIAL LIST OF MANUFACTURERS OF EQUIPMENT

The companies listed below supply equipment which may be used in making dried honey. The item numbers refer to the sheet entitled "Equipment for Dried Honey." Reference to these companies does not imply an endorsement of them by the U. S. Department of Agriculture over others not mentioned.

### 1. Feed Tank

Pfaudler Co., East Ave. and Walter St., Rochester 3, N. Y.  
 Lee Metal Products Co., 408 Pine St., Phillipsburg 8, Pa.  
 Groen Mfg. Co., 4535 Armitage Ave., Chicago, Ill.

### 2. Feed Pump

Waukesha Foundry Co., Waukesha, Wis.  
 Creamery Package Manufacturing Co., 1243 W. Washington Blvd., Chicago 7, Ill.  
 Robbins and Myers, Inc., Pump Division, Springfield 99, Ohio.



3. Heater  
Pfaudler Co., East Ave. and Walter St., Rochester 3, N. Y.  
Ross Heater and Mfg. Co., Inc., 1407 West Avenue, Buffalo  
13, N. Y.  
Struthers Wells Corporation, Warren, Pa.
4. Hot Water Tank  
Any local supplier of wood tanks
5. Pump  
Allis Chalmers Co., Milwaukee 2, Wis.  
Bell and Gossett Co., Morton Grove, Ill.  
Fairbanks-Morse and Co., 600 South Michigan Ave., Chicago 5, Ill.
6. Evaporator  
Rodney Hunt Machine Co., 117 Vale St., Orange, Mass.  
Blaw Knox Co., Buflovak Equipment Div., 1575 Fillmore Ave.,  
Buffalo, N. Y.  
Pfaudler Co., East Ave. and Walter St., Rochester 3, N. Y.  
The Kontro Co., Inc., North Main Street, Petersham, Mass.
7. Steam Jet  
Schutte and Koerting Co., 2229 State Road, Cornwell Heights,  
Bucks County, Pa.  
Croll-Reynolds Engineering Co., Inc., 17 John St., New York  
38, N. Y.  
Ingersoll-Rand, 2037 Chestnut St., Philadelphia 3, Pa.
8. Tank  
Any local supplier
9. Water Pump  
Same suppliers as for Item 5.
10. Product Pump  
Eco Engineering Co., 12 New York Avenue, Newark, N. J.  
The pump should be equipped with a mechanical rotary seal.
11. Flaker  
F. J. Stokes Machine Co., 5500 Tabor Road, Philadelphia 20, Pa.  
Blaw Knox Co., Buflovak Equipment Division, 1575 Fillmore Ave.,  
Buffalo, N. Y.  
Davenport Machine and Foundry Co., Davenport, Iowa

12. Conveyor  
A. K. Robins and Co., Lombard and Concord Sts., Baltimore  
2, Md.  
Food Machinery Co., Hoopeston, Ill.  
Chisholm-Ryder Co., Inc., Niagara Falls, N. Y.
13. Comminuter  
In the experimental work this item was made from a 12 inch diameter, flat, horizontal, stainless steel screen of 6-mesh. The flakes were rubbed through the screen by 3 stainless steel rakes attached to a shaft rotating at approximately 20 RPM. Detailed construction drawings will be furnished if requested. For commercial operations, a water cooled, low speed disintegrator could be used. The product during grinding should not exceed about 75° F.
14. Conveyor  
Same Suppliers as Item 12.
15. Packaging  
Local suppliers for small wood hopper and for suitable scales to weigh product into "50 pound" lard cans.
16. Water Chiller  
Acme Industries, Inc., Jackson, Mich.  
Carrier Corporation, Syracuse, N. Y.  
York Corporation, York, Pa.
17. Low Humidity Room  
This room can be made of plywood with a suitable vapor barrier to prevent diffusion of water into the room. Equipment for drying the air supplied to the room can be furnished by:  
  
Pittsburgh Lectrodryer Corp., P.O. Box 1766, Pittsburgh, Pa.  
Surface Combustion Corp., Toledo 1, Ohio  
Niagara Blower Co., 405 Lexington Ave., New York 17, N. Y.

#### ACKNOWLEDGMENT

The assistance of Jonathan W. White in furnishing information on the honey industry and of Norman F. Roger<sup>7</sup> in operating the pilot plant equipment is gratefully acknowledged.

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<sup>7</sup> Now with A. F. Murch Company, Paw Paw, Mich.



